INL's Mike Modro

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DOE Pulse

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Research Highlights . . .

Robotic aircraft tested as firefighting tool

National Aeronautics and Space Administration representatives are working with DOE's Idaho National Laboratory engineers to test unmanned aerial vehicles as part of a NASA-sponsored program to evaluate potential fire-fighting support from small robotic planes. Today's big fires are mapped using manned aircraft, fitted with thermal sensors that fly at night over hot spots and fire perimeters. NASA and INL engineers are investigating whether it makes sense to use flocks of small, inexpensive UAVs carrying a variety of sensors for such routine surveillance. NASA, INL and Forest Service engineers are looking for technologies that are reliable, user-friendly, and either improve the speed and safety, or decrease the cost of firefighting.

[Kathleen Gatens, 208/526-1058, Kathleen.Gatens@inl.gov]

New detector could thwart nuclear smugglers

Scientists at DOE's Los Alamos National Laboratory have developed a detector to see through lead or other heavy shielding in truck trailers or cargo containers and detect uranium, plutonium or other similar materials. The technique, called muon radiography, uses the cosmic rays that constantly bombard Earth and is far more sensitive than the x-ray or gamma ray detectors now in use. Detectors above and another pair beneath a truck or cargo container record each muon's path before and after it passes through the cargo. By analyzing changes in energy and trajectory, computers build a three-dimensional mathematical map of dense items in the cargo.

[Jim Danneskiold, 505/667-1640, slinger@lanl.gov]

Following nature's lead

Those seeking to design more efficient catalysts might do well to look at how chemistry works in nature. Brookhaven Lab scientists have identified a bacterial enzyme with a catalytic complex that their theoretical calculations predict should be four to five times more reactive than catalysts currently used for producing hydrogen and controlling air pollutants. Next they'll see if they can use the enzyme itself, or synthesize a mimic of its reactive center — an engineering feat on the nanoscale. Once they have the nanoparticles, the scientists will test their reactivity to see if the "naturally" engineered catalyst works as well as theory predicts.

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DZero delves into diboson data developments

End-on view of one of three WZ events.

The Tevatron collider at DOE's Fermilab is the only particle accelerator in the world that could ever produce both W and Z bosons, which carry the weak force, in the same collision. The W boson is 85 times the mass of a proton; the Z is even more massive. The W and Z quickly disintegrate into lighter particles, which are spotted in the DZero detector. DZero scoured approximately 14 trillion collisions produced between April 2002 and June 2004, finding three events containing both a W and a Z. With these three candidates, DZero is able to estimate the rate the Tevatron produces W-Z events, and set constraints on the strength of the interaction between the W and Z.

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DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***DOE Pulse*** (www.ornl.gov/news/pulse/) is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

MRI experiment starts at PPPL

The formation process of stars and planets remains one of the big questions in astrophysical science. Currently, scientists do not understand the required conditions and the accretion, or matter collection process, involved in star and planet formation. But the Magnetorotational Instability (MRI) experiment at DOE's Princeton Plasma Physics Laboratory may shed light on this mystery.

Galaxies and solar systems have a preferred direction of rotation. Consequently, matter forming these systems must also have had net angular momentum, which must have been overcome by gravity for the matter to coalesce. The angular momentum prevents matter from falling into the star directly, so an accretion disk is formed, which consists of matter losing it angular momentum and swirling into the core of the star Since angular momentum must be conserved, the lost amounts must be efficiently transported elsewhere. But how does this happen, and where does the angular momentum go?

The project's primary mission is to test the plausibility of a 1991 theory that indicates magnetorotational instability, a disruptive plasma process, plays a major role in accretion. The experiment does not use an actual plasma. Princeton scientists physically simulate an accretion disk with material "standing in" for the plasma, dust, and other materials.

The system they are using consists of two concentric cylinders, each 28 centimeters in length, free to rotate independently about a common axis at significantly different speeds. The inner cylinder has a radius of 7 centimeters and is made of steel, and the outer cylinder has a radius of 20.3 centimeters and is made of plastic to allow visual inspection. The space between the cylinders is filled with a mixture of liquid gallium, indium and tin, which interacts with the magnetic field in ways similar to plasma.

Experiments are being conducted with and without a magnetic field parallel to the axis of the cylinders. Researchers measure the differences in the torque on the cylinders between both conditions. The magnetorotational instability, when it occurs in the liquid metal, will cause angular momentum to be transferred from the inner cylinder toward the outer cylinder, resulting in an increase in torque-couplings between cylinders. This is equivalent to the transfer of angular momentum outward in an accretion disk, allowing matter to fall toward its center, forming a star. This result would support the hypothesis that MRI is responsible for the transport of angular momentum.

Submitted by DOE's Princeton Plasma Physics Laboratory

INL engineer focuses on worldwide nuclear energy

Mike Modro

Twenty-five years ago, Mike Modro moved from Austria to Idaho to work at what was then known as the Idaho National Engineering Laboratory. For nine years, he worked as a foreign attaché for the Austrian government at the Loss of Fluid Test facility, involved in nuclear safety research. Then, the Chernobyl accident in 1986 effectively ended the nuclear industry in Austria. Modro was told if he wanted to return to his homeland, he could work on windmills. He chose to stay in the United States.

Modro and other engineers at today's Idaho National Laboratory now work with the International Atomic Energy Agency and the Department of Energy promoting safety enhancements in nuclear power plants worldwide. He explains, "We've participated with many countries in Central and Eastern Europe to provide them with training that has contributed significantly to the growth of safety in their nuclear reactors." Those countries include Russia, Ukraine, Slovakia, Hungary, Armenia, Lithuania, Bulgaria and others. "We've shared our training, and now they are establishing independent safety thinking at the power plants in those countries," he says.

Modro still has an international focus in his current work on the Generation IV Supercritical Water-cooled Reactor. He is excited about the project because it's the only one of the six Gen IV designs with roots in industrial capabilities both nuclear and non-nuclear. "This design promises good economics with both capital investment and efficiency," he says. Modro emphasizes the need for the Generation IV project. He says, "It's good to see that there are utilities considering building reactors again, taking steps for licensing. If we can get the Gen IV designs operating, then the nuclear energy industry will really be revitalized."

When he's concluded his nuclear energy revitalization work years from now, Modro says he is confident the efforts of this international group will make things better for the world.

Submitted by DOE's Idaho National Laboratory